Look, My Baby Is Using an iPad!

An Analysis of YouTube Videos of Infants and Toddlers Using Tablets

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ABSTRACT
We know very little about the use of computers by children under the age of three. While few children in that age range used computers before the advent of smartphones and tablets, these devices have made computers much more accessible to infants and toddlers. In this paper, we provide a window into how these children are using tablets through an analysis of relevant YouTube videos. A majority of children aged 12 to 17 months in the videos in our dataset showed at least moderate ability to use the tablets. For children aged two, it was over 90 percent who displayed at least moderate ability. Our analysis also includes trends in interaction styles, child and device positioning, social aspects, and app genres. These findings point both to opportunities for research and starting points for design.

Author Keywords
Baby; infant; toddler; young child; iPad; tablet; Android; mobile device; touchscreen.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

INTRODUCTION

We know very little about the use of computers by children under the age of three. The historical reasons are that interactions through widely available hardware required the use of an indirect pointing device or keyboard until a few years ago, which could still be challenging at age three or four [10, 11, 12, 27, 29]. Tablets have lifted this restriction, as interacting through touch matches the motor abilities of much younger children [6].

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We also know that parents are providing children with access to tablets [8]. A quick search on YouTube yields scores of videos of infants and toddlers using tablets. What we do not know is how children are making use of these devices, and whether they can make meaningful use of them.

These are important questions to ask because those early years of life are crucial to children's development [13]. Adding interactive computing to children's lives at such young ages could lead to significant shifts in children's interactions with the world around them.

To begin to answer these questions, and inspired by Anthony et al.'s study of YouTube videos showing touchscreen use by people with motor impairments [3], we decided to follow a similar route and study YouTube videos of infants and toddlers using tablets. The videos provided us with examples of real-world use of the devices and helped us identify patterns of use by age group.

Based on our analysis, a majority of children aged 12 to 17 months in the videos in our dataset showed at least moderate ability to use the tablets. For children aged two, it was over 90 percent who displayed this ability level. Our analysis also includes trends in interaction styles, child and device positioning, social aspects, and app genres.

In the following sections we first discuss related research, including developmental milestones, child development theories, and existing research on computer and television use by young children. We then present the research questions, method, and results of the study, followed by a discussion of the results and future work, and the conclusion.

RELATED RESEARCH

Developmental Milestones

To better understand infants and toddlers and how they may use computers it is useful to refer to developmental milestones. The United States Centers for Disease Control (CDC) is one of many agencies and associations throughout the world to publish these. They are collections of typical

behaviors by age, and mostly intended for parents to quickly identify any developmental delays.

Below, we present relevant developmental milestones for key age groups, based on a brochure from the CDC [6]. These correspond to the age groups we used in our analysis of the videos.

By six months of age, children are typically able to recognize familiar faces, play with others, and respond to emotions. They can recognize their name, respond to sounds by making sounds, and can vocalize vowel sounds. They are curious about items around them, often reaching for them, or bringing them to their mouth. They can support their weight on their legs when standing, and begin to sit without support.

When they reach one year of age, children typically show behaviors related to attachment to primary caregivers, such as crying when they leave, and being nervous around strangers. They can respond to simple spoken requests, can use simple gestures, such as waving goodbye, and begin to say simple words such as "mom" or "dad". They explore objects by interacting with them in various ways (e.g., hitting, shaking), look at the right picture or object when it is named, copy gestures, and can poke with the index finger. This suggests they would be able to perform simple interactions with a touchscreen device.

At 18 months, children typically become more social in their behavior, for example, being able to say several single words, handing objects to others as part of play, showing affection to loved ones, and using pointing gestures to bring attention to something. They know about the purpose of common objects, participate in pretend play, and are able to scribble on their own. In terms of gross motor skills, they are typically able to walk alone, and can also drink from a cup and eat with the help of a spoon. The use of purposeful pointing and scribbling suggests more advanced interactions with touchscreen devices may be possible.

By their second birthday, children typically copy behavior they see in parents and older children, and can get excited when playing in a space where there are other children. They can recognize the names of familiar people and objects, follow simple instructions, speak using short sentences, and repeat words. They may be able to sort items by shape and color, play simple make-believe games, begin to show hand preference, and can name items in a picture book. In terms of skills that would impact touchscreen use, they are typically able to make copies of straight lines and circles.

Child Development

How do children change as they go through these milestones? Child development researchers study change in children. Perhaps the best-known theories on child development come from Jean Piaget, who developed the idea of adaptation, where learning and development occur as children adapt to their environment. Socio-cultural approaches, such as those developed by Lev Vygotsky made a greater emphasis on the social aspects of learning and the tools available in the environment, and argue that learning and development have to be understood within a particular socio-cultural context [9].

More recent systems approaches (e.g., connectionism) to development connect Piagetian and socio-cultural approaches with what we know about the biology of the brain [31].

One of the main emphases of these systems approaches is the notion of embodiment [31]. They see learning and development occurring through interactions between the brain, the body, and the environment (including other people). When we learn to complete a task, we learn how to do it with our bodies, using the resources available in the environment. As learning, change, and development occur, the brain, the body, and the environment learn, change, and develop together.

These approaches also bring a "biological systems" view of the brain, with small components working together to accomplish tasks, and knowledge representations, behaviors, and skills emerging over time [31]. Emerging skills, for example, are likely to show a great deal of variability initially, with the best alternatives becoming more likely over time. This also links to the concept of plasticity, where it is much easier to change behavior and learn new skills for younger people (they also show greater variability in behavior) but it is more challenging later in life.

How does all this link to tablets? Tablets have opened up a significant opportunity for change in early childhood environments. They may be the most malleable tools infants and toddlers have ever been able to use. The problem is that we know very little about how they are being used, and what impact they are having on children.

Screens, Computers, and Young Children

There are some clues as to what to expect from infants and toddlers' use of tablets based on what we know from the literature on young children (generally aged three and older) and their use of computers, and what we know about children and television.

A first question to ask would be how much time children spend in front of screens. An Australian study of thousands of children who were randomly sampled found that two to three year old children spent a mean of almost two hours a day of screen time during weekdays in 2006, but there were no reports of videogame or computer time for that age group. For three to four year olds, weekday videogame and computer time averaged 6 and 17 minutes a day respectively in 2007 [30]. Note that this study predates the wide adoption of tablets.

What impact is this screen time having on children? Bavelier et al. [4] provide a useful review of the literature. Their conclusion is both reasonable and not surprising in that children's use of technology can have positive, neutral, or negative impacts, depending on what technology is used, and how it is used. Sweetser et al. [30] delved further into the different kinds technology by distinguishing between passive screen time, and active screen time. Among types of active screen time, they mentioned physically active screen time, which includes playing videogames that involve children moving (e.g., Nintendo Wii). They also discussed cognitively active screen time, which involves the use of cognitive skills as part of games or other activities.

Young Children and Computers

In terms of specifically studying the impact of computers on young children's learning and cognition, a group from Wayne State University has conducted the most thorough examinations. They have done so through studies with children enrolled in Head Start, a United States program that provides early childhood education, health, and nutrition to low-income children aged three to five. Their findings have been positive both in correlational and controlled studies.

Their first study involved administering a battery of tests to 122 children and combining that information with surveys filled out by caregivers. The researchers found that children who had access to a computer performed better on measures of school readiness and cognitive development, after controlling for children's developmental stage and family socioeconomic status [18].

Since that evidence was correlational, they then conducted a study in which they manipulated computer use by providing half the children with 15 to 20 minutes of access to appropriate educational software a day, while the other half participated in the Head Start curriculum. After six months, the group using computers performed significantly better on a school readiness test [19].

This was followed by a study with 136 children that delved into what type of home computer use was most beneficial. In this correlational study, children whose parents reported active involvement in their computer use scored higher on cognitive measures than children whose parents reported non-active involvement [21].

The final study from this group of researchers was also correlational and involved 200 children. They found that using a computer correlated with some aspects of cognitive development after controlling for parental education and income [7].

Reflecting on the reasons why computers benefited children, the Wayne State University research group [20] speculated it was due to computers helping children benefit from a variety of learning experiences, being interactive, and contributing to problem solving and learning. In addition, they argued that computers can motivate children, and often involve interactions with others.

Other researchers who conducted similar studies include Castles et al. [5], who found a positive correlation between computer use and letter knowledge even after controlling for cognitive and environmental factors, based on a survey and testing of 1539 four year old children. Plowman et al. [23, 24] studied the use of computers in the homes of similarly aged children (three to four years old). They did so through a survey of over 300 families and 24 case studies. Through their study, they identified areas where parents could have typically provided more support for their children: acquiring basic interaction skills, building confidence and independence in the use of computers, learning how to use them to learn about topics such as mathematics and language, and understanding the role of technology in everyday life. Tablets could potentially lower some of these barriers.

The main criticisms and controversy with regard to the impact of computers on young children comes mostly from speculation of possible negative impacts [1, 9, 20]. They include the possibility that computers could lead to social isolation, that they could be used for entertainment instead of educational activities, that they could affect the development of perceptual and motor skills, provide access to inappropriate content, lead to physical injury (e.g., if a computer falls), or obesity due to lack of physical activity.

Within the human-computer interaction community there has been little research conducted with very young children. The earliest studies on young children's computer use came from researchers who then worked at *Sesame Workshop*. They were interested in the most appropriate input devices for children as young as three years old, and conducted experiments that generally supported the use of the mouse and the trackball [27, 29] over other input devices. At the time, tablet-like devices were not easily available.

More recently, Raffle et al. worked on systems to enable remote communication between young children and family members. One of the systems, *Family Story Play*, supported dialogic reading activities between children and grandparents [25]. The system included a paper book, two screens, and sensors. They continued their work with *StoryVisit*, a system with a similar goal as *Family Story Play,* but one that relied fully on software [26]. Through an evaluation, the researchers found the most engaged age group to be three-year-old children. The company *Kindoma* then used similar ideas for their apps.

The existing literature suggests that young children may benefit from using computers under the right circumstances. At the same time, it is clear that we know very little about the use of computers by children under the age of three, and even less for children under the age of two.

Television Studies

Another area of research that has some relevance to young children's use of computers is what we know about the impact of viewing television. Obviously, most interactions with computers are likely to be more active than those with television, but they share some of the concerns raised by critics of young children's use of computers. The results of studies suggest that the effect of television is highly dependent on the type of programs watched and how children watch them.

An example of this came from a study by Linebarger and Walker [17] who surveyed parents every three months about their children's television viewing from the time the children were six months old, until the age of 30 months. The sample included 51 children. After controlling for parental education, home environment, and the children's cognitive performance, they found, not surprisingly, that different programs had different impacts. In particular, children who viewed *Dora the Explorer, Blue's Clues, Arthur, Clifford,* and *Dragon Tales* had greater vocabularies and higher expressive language scores. On the other hand, watching *Teletubbies* correlated with fewer vocabulary words and lower expressive language scores. The common characteristics of the shows that led to better results included child-directed speech, elicitation of responses, object labeling, and/or a coherent storybook-like framework.

A similar, but much larger, study by Schmidt et al. [28] did not delve into actual shows, but followed 872 children with reports on television viewing habits at six months, one year, and two years of age. They then conducted an evaluation of language and visual motor skills at age three. They found that after adjusting for maternal age, income, education, picture vocabulary test, marital status, child's age, gender, birth weight, breastfeeding, race/ethnicity, primary language and speech, that television viewing was not associated with language or visual motor skills at age three.

Another large study by Zimmerman et al. [32] consisted of a single survey of 1008 parents of children aged 2 to 24 months. They found that after adjusting for sex, age, number of siblings, premature birth, hours per week in daycare, parental presence, income, race/ethnicity, and state of birth, viewing of baby-oriented videos (e.g., *Baby Einstein*) was correlated with a significantly lower score in Communicative Development Inventory score for children aged 8 to 16 months. Other types of content did not have a significant impact.

To summarize, there is more information about the impact of television on infants and toddlers than about the impact of computers. In particular, the research literature points at a complex set of factors that influence whether television has a positive or negative impact. Of particular note is that certain types of shows are more likely to lead to cognitive gains. This nuanced view stands in contrast to the recommendations by the American Academy of Pediatrics of avoiding screen time for children under the age of two [2].

RESEARCH QUESTIONS

Given the significant lack of empirical data on the use of computers by children under the age of three, the main research question we sought to answer in this paper is how infants and toddlers are using tablets. We decided to focus on tablets because we believe they have made computers accessible to the youngest children in ways that were not possible with keyboards and indirect pointing devices.

More specifically we wanted to answer the following questions about infants and toddlers and tablets:

- Can they make meaningful use of tablets?
- What type of interactions are they using?
- How do they position the device and themselves?
- Are they using tablets together with others?
- What type of apps are they using?
- How do the answers to these questions change for different age groups?

METHOD

Identifying Relevant Videos

We used YouTube's search to identify relevant videos. To begin with, we searched for combinations of a word related to a young child (baby, infant, toddler, kid, child) and the word "iPad". As an alternative, we also searched for the same child-related terms and the word "tablet" instead of "iPad". We also used a translation tool to substitute the term "baby" for its equivalent in several other languages (French, Spanish, Portuguese, German, Japanese, Korean).

For each search, we looked through the first 200 results, or all results if less, and added any videos that appeared relevant (i.e., may involve a child under three years old using a tablet) based on search result information to a playlist that helped us easily identify duplicates. As we watched the videos, we often saw listings of related videos or playlists that provided additional, relevant results. We added these videos to the playlist if they were not already present.

While watching the videos on the playlist, we also ran into situations where we learned that the video did not fit our criteria – there were no children in our desired age range using a tablet – and we removed these videos. We also removed videos if they did not include the age of the child and we could not see enough of the child to determine age, if we could not see what the child was doing with the device, or if the device was not a tablet.

Coding Videos

Two members of the research team gathered basic information about the videos including URL, title, YouTube username, and length. Then, one member coded each video for the age of the child (with a best guess if not specified), gender, ability to use the tablet and app(s) (from

1 to 5 based on the ability to control and comprehend), languages used, emotions displayed by the child, context, number of people participating other than the child, physical position of the device, physical position of the child, use of fingers, use of hands, use of gestures, and genre of app used.

More specifically, the ratings for ability indicated the following:

1- No or very low ability (i.e., randomly touches the device)
2- Low ability (i.e., purposeful actions, but no full understanding of app(s); little accuracy)
3- Moderate ability (i.e., some difficulty with basic interactions, but able to use app(s); needs assistance to get to child-oriented app(s))
4- High ability (e.g., able to navigate to app(s), and use app(s), but occasionally makes mistakes)
5- Very high ability (e.g., has no problem navigating to and using app(s))

We were particularly concerned with the validity of our coding of age and ability. To address this concern, a second rater went through all the videos and coded the age, as well as noted whether a guess was required. For 66 percent of videos, the rater was able to get the age of the child from the video through the title, the description, or by having access to one of the former in another video featuring the same child (and adjusting the age based on the date of the video). For agreement at the 6 six month grouping level used in our statistical analysis, the intraclass correlation coefficient [14] was .871 for individual measures (reliability of scale=.931), p<.001.

To ensure the validity of our coding of children's ability, a second rater watched four randomly selected videos for each of the five points in the scale. Then, the rater rated another 55 randomly selected videos (no overlap). The intraclass correlation coefficient was .655, and the reliability scale was .792 (p<.001).

DATASET DESCRIPTION

Video Characteristics

The dataset consisted of 208 videos. Their median length was 93 seconds (minimum=13, first quartile=51, third quartile=160, maximum=1420).

Child Characteristics

The children included 57 under the age of 12 months (17 under six months), 43 between 12 and 17 months old, 49 between 18 and 23 months old, and 59 who were 24 to 29 months old. For convenience, we have organized our analysis around these four age groups.

While gender was roughly evenly divided, there were more girls than boys in the videos through 23 months of age, with a sharp change in favor of boys in videos featuring children aged 24 months and older (see Figure 1). In fact, the distribution for the oldest age group was roughly two-to-one in favor of boys.

Devices Used

An overwhelming majority of devices used in the videos were Apple iPads, with only 27 videos featuring other tablets.

Context

YouTube users filmed almost all their videos at home, with only one video filmed in an office. A majority of the videos featured English as the only language, with 30 featuring another language.

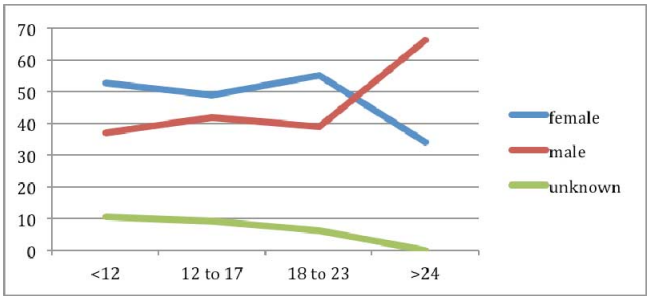

Figure 1. Percent of participants by gender and age group, in months.

RESULTS

We analyzed the data using SPSS 21. Our goal was to understand the changes that typically occur with age in the way children use these devices. For a majority of variables, we analyzed them by age group (<12 months, 12-17 months, 18-23 months, and 24-29 months). To learn if age group had a statistically significant effect on a variable we used logistic regression if the variable was categorical (e.g., the position of the device), and non-parametric correlations for ordinal variables.

Ability to Use

We coded ability to use on a scale of 1 to 5, with 1 being no or very low ability, and 5 being very high ability to comprehend and control the device and app(s) being used. Figure 2 shows a scatterplot, with age in months on the x-axis, and ability to use on the y-axis. A power trendline was the best fit to the relationship, yielding an R^2 value of .51.

Figure 3 shows a clearer picture of the distributions of ability to use by age group. It shows a pattern going from having about 90 percent of children under 12 months of age at levels 1 or 2, with a similar percentage at levels 3 to 5 for the group between 24 and 29 months of age.

Interaction Styles

Number of Hands

One of our main interests was to learn about how children interacted with the devices. The first variable we analyzed was how many hands children used to interact with the

device. This analysis yielded a clear trend, with use of two hands more common for younger children, and one hand more common for older children (see Figure 4). A Spearman correlation between age group and the number of hands used was statistically significant ($p<.001$, correlation coefficient =-.286).

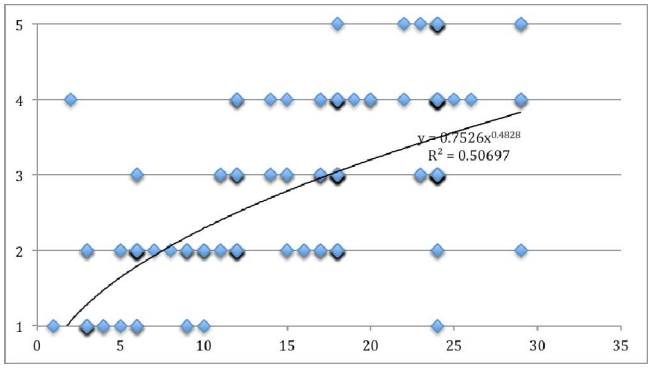

Figure 2. Scatterplot showing ability to use on the y-axis (on a scale of 1 to 5, with higher scores corresponding to greater ability to use) and age in months on the x-axis. The trendline shows a power relationship between age and ability to use.

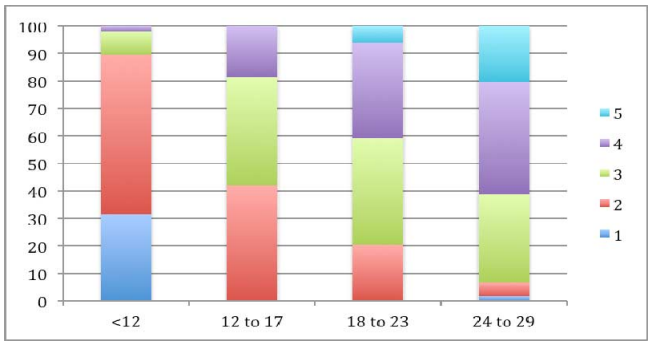

Figure 3. Percentage of children reaching a particular level of ability to use (on a scale of 1 to 5, with higher scores corresponding to better ability to use), by age group in months.

Figure 4. Percentage of children (on the y-axis) using one or two hands (lines) by age group in months (on the x-axis).

Use of Fingers and Gestures

We then analyzed how children used their hands, including how many fingers they used, and what type of gestures they used. Figure 5 shows clear trends. The more salient ones involve a sharp decrease with age in the use of the full hand, multiple fingers, and hitting the device. This is accompanied by a sharp increase in single finger interactions by tapping. There is also a slow, but steady increase in the use of dragging gestures. The only gesture that follows an odd path is swiping, which increases for children between 12 and 17 months of age, and then decreases again.

Based on logistic regressions, all variables fit the model ($p<.001$ in all cases), meaning that age group had a significant effect on them.

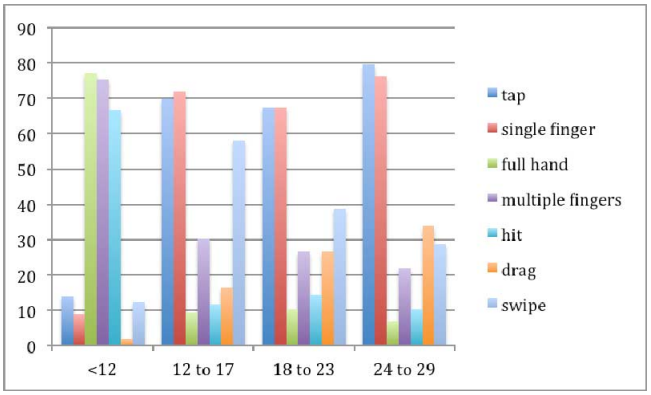

Figure 5. Percentage of children (on the y-axis) who made particular use of their hand or fingers by age group in months (on the x-axis).

Device Position

In terms of device position, we classified this into four separate categories: held by child, held by an adult, lying flat on a surface, or propped up by some object. In many videos, especially for older children, we saw more than one way of holding the device in the same video. Figure 6 shows one clear trend with older children more likely to hold the device ($p<.005$ for the model). The other variable that showed statistical significance was whether the device was held by an adult ($p<.05$ for the model). Both having the device flat or propped up held relatively steady, although having devices flat on a surface was roughly twice as popular.

Child Position

We classified children's positions while interacting with the device into standing or walking, sitting, and lying down. In this case, there were no clear trends, except for the fact that sitting was the most popular position. See Figure 7. Age group only had a statistically significant effect on lying down based on logistic regression ($p<.005$).

Other People in Video

We analyzed the number of people who appeared in videos, other than the child and the person filming. We only counted people who had an active role in the activity (e.g., we did not count people who happened to walk by in the background). Figure 8 shows how between 30 and 50 percent of the time there is another person participating in the activity. In this case, logistic regression did not yield statistically significant effects.

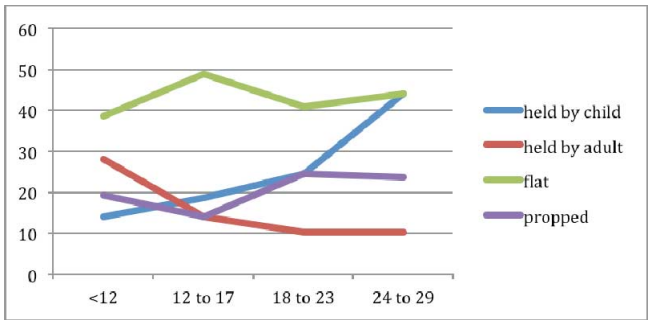

Figure 6. Percentage of videos (on the y-axis) featuring a particular device position (lines) by age group in months (on the x-axis).

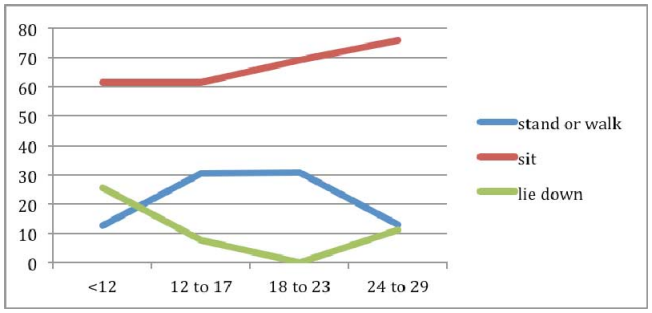

Figure 7. Percentage of videos (on the y-axis) with the child in a particular position (lines) by age group in months (on the x-axis).

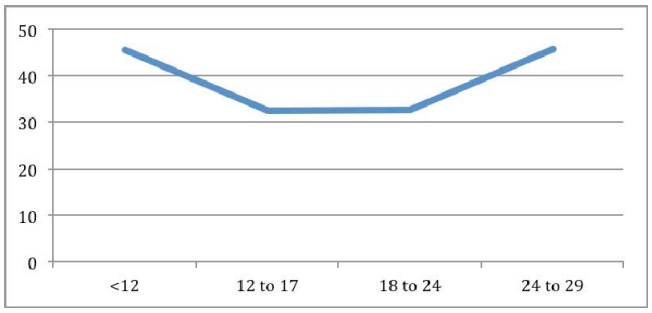

Figure 8. Percentage of videos (on the y-axis) in which another person other than the child and the person filming played an active role in the activity by age group in months (on the x-axis).

App Genres

When we were able to see the screen, we classified the genre of the app(s) the child used. The genres we observed were: games, educational, video, music, pictures, and lifestyle (e.g., potty training, image distraction for babies). Logistic regression yielded a statistically significant effect of age group for all genres, except for video and pictures ($p<.001$ for music, $p<.005$ for games and educational, $p<.05$ for lifestyle).

Figure 9 illustrates these trends. Music was the most popular genre for the youngest age group, but the popularity of this genre drops to about ten percent of cases for older children. Games and educational apps see the opposite trend, from being a distant second and third for the youngest group, to dominating the videos in the dataset for the oldest group.

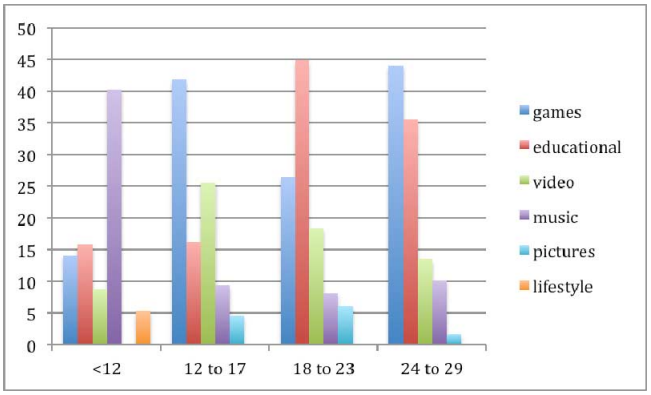

Figure 9. Percentage of videos (on the y-axis) featuring a particular app genre by age group in months (on the x-axis).

Emotions

Emotions displayed by children in the videos were overwhelmingly neutral (in 190 of the videos), with the remaining videos split between 15 displaying positive, and three displaying negative emotions.

DISCUSSION

Characterization by age group

The analysis of YouTube videos presented in this paper provides us with a sense of how infants and toddlers are using tablets. Below we discuss typical characteristics of use for each age group, which may be useful as starting points for designs.

Under 12 Months

A majority of children under 12 months (90 percent) in our sample did not display a moderate ability to use the app(s) they were using on a tablet. Their most common form of interaction was hitting the tablet with a full hand, using multiple fingers. They were almost twice as likely to use both their hands, than only one hand. Tablets were most often laid flat for them to use, with an adult holding the tablet coming second in terms of device position. Most of

the children this age (almost 90 percent) used the tablet while sitting or lying down. Almost half used the device together with another person. In terms of app genres, music apps were the most popular for this age group, enabling children to use gross motor control to generate sounds.

12 to 17 Months

Children in this age range were much more likely to display a moderate ability to use the devices, with over half of the children we observed at this level. This coincides with a significant shift from interacting with full hands by hitting the device, to interacting with a single finger by tapping on it. There was also a shift from primary use of two hands to interact, to using only one hand slightly more often than two. Device positioning was similar to the younger age group, except for a decrease in adults holding the device, and an increase in the likelihood that children will hold the device. While the most common position for children continued to be sitting down, there was a decrease in the likelihood of children lying down together with an increase in children standing up. There was also more independence in the use of the tablets, with about two thirds of children this age using the tablets by themselves. In terms of app genres, games were dominant, followed by video apps.

18 to 23 Months

A clear majority of children aged 18 to 23 months old (about 80 percent) were able to achieve at least moderate ability in their use of the devices. Interactions involved again primarily tap actions with a single finger, with drag interactions rising significantly. There was also an increased likelihood of using only one hand instead of two (about two-to-one ratio). As in every other age group, devices were most likely to be lying flat. For this age group there was an increase in the likelihood of children holding the device, as well as the device being propped up. Children's positions and the participation of others in the tablet activities stayed similar to the levels for children 12 to 17 months of age. In terms of apps, there was a significant increase in the use of educational apps for this age group, which were followed in popularity by games.

24 to 29 Months

Over 90 percent of the children in our sample who had turned two years old showed at least moderate ability to control and comprehend the app(s) they used. We continued seeing most interactions occur through single-finger taps, with a continued increase of drag interactions, and even more dominance of one hand. In terms of device position, there was an increase in the likelihood that children would hold the tablet, which together with having it lying flat was the most common position. There were no major changes in children's positions, although there was a slight increase in the number of people other than the child participating in the use of the tablet. In terms of apps, games and educational apps were by far the most popular.

Gender

A surprise we had when analyzing the data was the dramatic shift in gender balance from having a slim majority of videos featuring girls through 23 months of age, to having a two-to-one ratio of boys-to-girls for children aged 24 months and older. This distribution is inconsistent with previous studies looking at access to computers and frequency of use by gender for preschool children [18]. It could also be due to boys being more frequently referred to as toddlers when they reach age two, while girls may be more frequently referred to as girls, which was not part of our search criteria. Another possibility is that gender preferences for computers, either by the parents or children, start at this early age.

Addressing Concerns

The analysis of the videos suggests that many of the concerns raised about young children and computers [1] may not be justified. In particular, a significant portion of videos involved social use of the devices, educational apps were similarly popular to games, and many of the apps appeared to enable children to practice perceptual and motor skills. While tablets could still be used in ways that may lead to negative outcomes, recommendations of no screen time seem exaggerated and based at least in part on incorrect assumptions.

Limitations

There are some obvious limitations with the approach used to obtain the data analyzed in this paper. The videos posted on YouTube come from a set of children selected by their caregivers, which may not represent the full diversity of users. Since we did not obtain the videos from a random sample of the population, the results of inferential statistics should be taken with caution, while focusing on the descriptive statistics. It is also worth keeping in mind alternative approaches, such as surveys and direct observation, would have also involved self-selection or non-response, and may not have included the geographic and cultural diversity we found in our sample.

We can also consider whether the behavior in the videos was atypical for the featured children, and whether the children are atypical. The first concern should be alleviated by the length of the videos, with the median at 1m33s. If children had amazing luck in using an iPad, showing unusual performance, it would be unlikely to happen for that long. In terms of the children having atypical abilities, they did not do anything that is not within developmental milestones.

It is also possible that caregivers may have avoided posting videos featuring children who are frustrated at not being able to use their devices. That said, we did see a clear progression by age in the type of interactions children were capable of successfully performing.

Perhaps the main limitation given the questions in this topic is that our research methodology did not enable us to track children over time to understand the impact of their use of tablets on their development. However, such a study would have been significantly more costly than this one, and we consider this to be a useful first step in learning about the topic.

Another obvious limitation is that this was not a controlled study. We were not able to control what the children did with the devices, where they did it, how they went about interacting with the devices, or who was there with them. On the other hand, there is an advantage in seeing how these devices are used in real-world circumstances, something that is often difficult to replicate in a laboratory study.

A final limitation is that we focused on tablets, while there is also use of smartphones. We thought for a first study it would be better to focus on one screen size. We also considered that tablets may be more appropriate for younger children, as larger screens could also include larger targets that are more appropriate for their developing motor skills.

FUTURE WORK

To complement this study, it would be a good idea to conduct a longitudinal survey based on a random sample of birth records for a particular geographic area, to obtain a different kind of sample and better understand the likelihood of children of a certain age using tablets, how they are using them, and how it affects their development.

It would also be useful to more deeply study the use of apps and see how often they include the factors related to success in television shows (i.e., child-directed speech, elicitation of responses, object labeling, and/or a coherent storybook-like framework) [17].

Beyond that, there is a clear opportunity to explore the design of apps for very young children, starting as early as 12 to 17 months of age. The evidence presented in this paper suggests a majority children in this age group and older can understand and use basic apps. The research question is how to design them such that they have similar characteristics to beneficial television shows, while helping children build communication, visual, and motor skills, and increase their connections to their caregivers (see a similar call by Lieberman et al. [15]).

CONCLUSION

We conducted a study of YouTube videos showing infants and toddlers using tablets. Our analysis of the videos provides a window into how they are using these devices. While most of the children under age one struggled to make meaningful use of the tablets, a majority of children aged 12 to 17 months showed moderate ability. In addition, more than 90 percent of children aged two reached this level of ability.

Our study also provides an account of interaction styles, device and child positioning, and social aspects of tablet use. Designers could use this information as starting points in the design of apps for these age groups.

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